

In the outstanding Official Action, Claims 1, 2, and 4-6 were rejected under 35 USC 103 as being unpatentable over U.S. Patent 3,587,561 to Ziedonis or U.S. Patent 4,281,550 to Erikson in view of U.S. Patent 4,344,327 to Yoshikawa et al or U.S. Patent 4,409,982 to Plesset et al. Claim 3 was rejected under 35 USC 103 as being unpatentable over Erikson or Ziedonis in view of Yoshikawa et al or Plesset et al in further view of U.S. Patent 4,479,069 to Miller or U.S. Patent 4,404,489 to Larson.

First, Applicants acknowledge with appreciation the courtesy of an interview granted to Applicants' attorney on February 10, 1986, at which time the outstanding issues in the case were discussed. During the interview, the above changes to the claims were proposed, and arguments substantially as hereinafter developed were presented. However, no agreement was reached, pending the Examiner's detailed reconsideration of the application upon formal submission of an amendment.

In response to the several grounds for rejection, Claim 1 has been amended to include limitations which accentuate features of Applicant's invention believed to be more clearly patentably distinguishing of Applicant's invention over the applied prior art. To that end, amended Claim 1 clarifies that the array of

the transducer elements includes a piezoelectric ceramic plate having electrode layers provided on opposed sides of the ceramic plate and a matching layer formed on a selected one of the electrode layers, wherein grooves are cut through the piezoelectric ceramic plate, the electrode layers and the matching layer to define individual transducer elements and to isolate the individual transducer elements. Antedecent basis for the above changes to Claim 1 are clearly found in Applicant's disclosure shown in Figures 4a and 4b. Further, Applicant refers to Applicant's specification at page 9, lines 17-24 of Applicant's specification, whereby enhanced isolation between transducer elements is achieved according to Applicant's invention. Accordingly, the above changes to Claim 1 are not believed to raise a question of new matter.

In light of the changes to Claim 1, Claim 4 has been cancelled and Claim 5 amended consistent with the changes to Claim 1. The above changes to Claim 5 likewise are not believed to raise a question of new matter.

The applied Ziedonis patent discloses an ultrasonic transducer assembly including a flexible printed circuit board 44 having a plurality of ultrasonic units 25-29 each including a transducer element 31 formed thereon. As shown in Figures 4, electrodes 38 and 39

are formed on the flexible printed circuit board 24. Ziedonis fails to teach the provision of the array of ultrasonic transducer elements as recited in Applicant's amended Claim 1, particularly including a piezoelectric ceramic plate having opposed sides, electrode layers provided on the opposed sides thereof, and a matching layer formed on a selected of the electrode layers with grooves being cut through the piezoelectric ceramic plate, the electrode layers and the matching layer through to the flexible backing plate. Indeed, the electrode structure taught by Ziedonis is completely different from that taught by Applicant, and Ziedonis^{#31} does not even teach the provision of a matching layer or the isolating grooves as recited in Claim 1. *See fig 6*

*Method
Limitation
Result is
plurality of
individual elements
Same as Ziedonis*

Erikson discloses an array of ultrasound transducers formed by means of a rectangular bar 600 of piezoelectric ceramic having copper electrodes 605 and 610 bonded to the front 601 and rear 602 major surfaces thereof and a flexible matching window 615 cast directly on the front electrode. As shown in Figures 7 and 9, grooves are cut through the rear electrodes 610 partially through the ceramic bar 600, and upon bending of the flexible window 615 cracks are formed at the bottom of the dividing grooves. Without a doubt, Erikson is deficient in not teaching grooves extending

entirely through the ceramic bar and rear electrodes. Instead, Erikson relies on irregular cracks in the ceramic bar 600 upon bending of the window 615, which leads to irregularities in the dimensions of the resultant transducers and the electric characteristics thereof and which does not provide the same level of isolation as grooves extending completely there-through. Like Ziedonis, Erikson fails to teach the provision of a matching layer which also has grooves cut therethrough, whereby isolation between adjacent transducers is further enhanced according to the teachings of Applicant's invention. Thus, it is respectfully submitted that Erikson fails to cure the deficiencies above noted in Ziedonis and that Applicant's amended Claim 1 patentably distinguishes thereover.

Applicant acknowledges that Plesset et al and Yoshikawa et al teach convex transducers. However, Plesset et al and Yoshikawa et al do not cure the deficiencies above noted in the Ziedonis and Erikson patents in that neither of these references teach the transducer array structure recited in amended Claim 1.

Similarly, Applicant acknowledges that Larson and Miller disclose the provision of flexible circuit boards containing conductive traces for making connection to piezoelectric elements. However, the patents

to Larson et al and Miller fail to cure the deficiencies above noted in the other references above discussed, since Larson et al and Miller likewise fail to teach the ultrasonic transducer array structure stated in amended Claim 1.

Of the remaining references of record, U.S. Patent 4,385,255 to Yamaguchi et al is believed to be the most pertinent. In Figure 4C of this reference, Yamaguchi et al discloses an ultrasonic transducer array in which individual transducer elements 11 having electrodes 1c, 1b formed on opposite sides of a piezoelectric layer 1a are defined by grooves cut therethrough. The individual transducer elements 11 are mounted directly on a backing member 2. In the embodiment shown in Figure 3, a matching layer 7 is provided on top of the array of transducer elements. Yamaguchi et al do not teach a provision of a flexible backing plate and do not teach the provision of grooves extending through a matching layer formed on electrodes. In view of these deficiencies, it is respectfully submitted that Yamaguchi et al do not cure the deficiencies above noted in the remaining cited references.

Consequently, in view of the above discussion, it is respectfully submitted that the pending claims, as amended herewith, patentably distinguish over the prior art of record and are in condition for formal allow-

ance. An early and favorable action to that effect is respectfully requested.

Respectfully submitted,

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